

1   **APPLICATION FOR PATENT**

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3   **TITLE: ROTO-ERECTOR FOR J-LAY PIPELAYING SYSTEM**

4   **RELATED APPLICATIONS**

5       None

6   **BACKGROUND OF THE INVENTION**

7       **1. FIELD OF THE INVENTION**

8       This invention relates generally to laying underwater pipelines in relatively deep  
9   water using a J-Lay method from a floating vessel and, more particularly, to installing  
10   underwater pipelines on the seabed and/or connecting the same to floating terminals at  
11   the surface.

12       **2. DESCRIPTION OF THE RELATED ART**

13       Subsea pipelines have most often been laid on the ocean floor by connection of  
14   welding on the deck of a barge, lowering off the back of the barge down a stinger or  
15   curved guide, and then laying on the ocean floor. The curve down off the barge and  
16   then reverse curve onto the ocean floor gives an "S" bend in the pipeline during the lay  
17   process. The stinger allows the pipeline and its associated weight to be curved down  
18   toward the ocean floor without kinking or damaging the pipeline. As water depths  
19   become greater; the size, weight, and cost of the stinger become prohibitive.

20       In deeper water, it is advantageous to connect the pipeline near vertically and  
21   lower it directly into the water, with a single bend at the ocean floor. This gives the  
22   shape of a "J" for a system known as J-Laying pipe. The "J" cannot be vertical at the  
23   top, but rather must have an angle with a horizontal component to be able to pull  
24   horizontal tension on the pipeline as it is being laid onto the ocean floor. If it does not

1 have horizontal tension, it will buckle as it is laid on the ocean floor and be damaged  
2 beyond use.

3         Sections of pipe are sequentially brought into the mast structure of a J-Lay  
4 system and welded to the end of the pipeline depending from the J-Lay system. As  
5 each section is welded in place, the pipeline is lowered by the length of the new pipe  
6 section and the vessel moves forward a similar amount. In most cases the vessel will  
7 move forward at a slow and continuous speed, whereas the pipeline itself is lowered in  
8 a stepwise fashion.

9         A common requirement for J-Lay systems such as this is to bring the new  
10 sections of pipe into the mast for welding. As the new pipe sections are normally stored  
11 horizontally, they must be erected to a near vertical position. An erector arm can be  
12 provided which will move the pipe about a pivot from horizontal to near vertical  
13 positioning. A crane or multiple jib cranes can be used to lift the pipe from the deck  
14 storage racks up to the gripping mechanisms on the top side of the erector arm.

15         A difficulty arises when the crane uses its cable to pick up a new pipe section it is  
16 sensitive to weather conditions. In still water it will not be difficult to move the new pipe  
17 section to the grippers on an erector. In marginal weather conditions, the motion of the  
18 vessel can cause a swinging motion of the new pipe section, making it difficult and  
19 potentially unsafe to try to land.

20         As the pipeline starts to swing, the operations become weather sensitive. It can  
21 cause the operations of the vessel to be shut down for safety of operating personnel,  
22 when productive operations could be carried on otherwise.

23         The present invention is directed to overcoming, or at least reducing the effects  
24 of, one or more of the problems set forth above.

## **SUMMARY OF THE INVENTION**

The object of this invention is to provide an erector for a J-Lay tower which will provide a positive control of the motion of the new pipe section at all times.

A second object of this invention is to provide means for controlling the position of the new pipe section in a way which will extend the weather window of operations.

Another object of this invention is to provide means to pick up a new section below an erector arm, move it above the erector, and present it to the mast.

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon referring to the drawings which follow.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

Figure 1 illustrates the apparatus for assembling and deploying pipe string underwater, mounted on the rear of a floating vessel and deploying a pipeline.

Figure 2 shows a more detailed perspective view of the apparatus.

Figure 3 illustrates the erector system of the embodiment in various angular positions.

Figure 4 shows an end view of the erector of this invention with the grabber deployed below the erector engaging a new section of pipe.

Figure 5 shows the grabber in the same angular position as is in figure no 4, with the grabber retracted toward the main erector arm.

Figure 6 shows the erector rotated to the vertical position above the main erector arm.

Figure 7 shows a side view of a portion of the erector showing the extension mechanism.

1 While the invention is susceptible to various modifications and alternative forms,  
2 specific embodiments thereof have been shown by way of example in the drawings and  
3 are herein described in detail. It should be understood, however, that the description  
4 herein of specific embodiments is not intended to limit the invention to the particular  
5 forms disclosed, but on the contrary, the intention is to cover all modifications,  
6 equivalents, and alternatives falling within the spirit and scope of the invention as  
7 defined by the appended claims.

#### 8 **DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS**

9 Illustrative embodiments of the invention are described below. In the interest of  
10 clarity, not all features of an actual implementation are described in this specification. It  
11 will of course be appreciated that in the development of any such actual embodiment,  
12 numerous implementation-specific decisions must be made to achieve the developers'  
13 specific goals, such as compliance with system-related and business-related  
14 constraints, which will vary from one implementation to another. Moreover, it will be  
15 appreciated that such a development effort, even if complex and time-consuming, would  
16 be a routine undertaking for those of ordinary skill in the art having the benefit of this  
17 disclosure.

18 Referring now to figure 1, the j-lay tower 10 is shown on a floating vessel 12 in a  
19 body of water 14 with a pipeline 16 extending below the j-lay tower 10 around a bend 18  
20 and onto the ocean floor 20. The j-lay tower 10 is shown with a mast 21 including a  
21 lower section 22, a middle section 24, and an upper section 26; a working table 28; and  
22 a skid 30. A new pipeline section 32 is shown on the erector 34. The erector can be  
23 pivoted up to the mast to deliver the pipe either by being pushed up by hydraulic  
24 cylinders or pulled up by a wire rope attached to the mast.

1 As can be noted, the tower is inclined at an angle convenient to the laying of the  
2 pipeline. Jack assemblies 42 assist in the changing of the tower angle as required.  
3 Stinger 44 provides internal rollers whose inner diameter provide a curvature to prevent  
4 overbending of the pipeline. The preferred running style is with the tower perfectly  
5 aligned to the pipeline, while using the angle gained around the curvature of the stinger  
6 as a margin of error if unforeseen events occur.

7 Referring now to figure no. 2, a perspective view of the apparatus is shown with  
8 the erector 34 shown partially raised toward the mast sections 22, 24, and 26. Main  
9 cylinders 50, with cables 52 over drums 54 are used to lift the travelling table 56 to  
10 power the system. Erector 34 is shown with main arm 60, pivot axle 62, and grabbers  
11 64 and 66. Grabbers 64 and 66 are shown in a position above erector main arm 60. As  
12 will be seen later, grabbers 64 and 66 and be rotated about the pivot axle 62 to a  
13 position below main erector arm 60 for picking up pipe.

14 Referring now to figure no. 3, the erector 34 with new pipeline section 32 is  
15 shown in the horizontal position at 70, raised 45 degrees at 72, and engaging the  
16 vertical mast at 74. It is pivoted about axles at 76. An additional new pipe section 80 is  
17 shown on pipe racks 82 and 84 waiting on being picked up by grabbers 64 and 66 when  
18 the grabbers 64 and 66 are rotated down about the pivot axle 62.

19 Referring now to figure no. 4, a partial view of figure no. 3 is shown taken along  
20 lines "4-4". Grabber 64 is shown pivoted down about pivot axle 62 and engaging new  
21 pipe section 80. Additional new pipe sections are shown at 90, restrained by a stop arm  
22 at 92. Cylinders 100 and 102 provide the power to rotate the grabber by pushing on  
23 arm 104 which is attached to pivot axle 62. Scissor mechanism 106 is used to extend  
24 and retract the grabber 64, as will be described later.

1 Referring now to figure no. 5, the scissor mechanism 106 has been retracted to  
2 allow the grabber to be rotated clockwise about pivot axle 62 to move new pipe section  
3 80 above main erector arm 60.

4 Referring now to figure no. 6, grabber has been rotated to the upper position,  
5 ready for engagement with the mast. In addition to being positioned for engagement  
6 with the mast, the scissor mechanism can be extended to give adjustment flexibility to  
7 the alignment of the new pipe section in the mast.

8 Referring now to figure no. 7, a partial view of figure no. 6 is shown which is  
9 taken along lines "7-7". Brackets 110 and 112 are attached to pivot axle 62 with arms  
10 114 and 116 attached. Collars 120 and 122 are slidably mounted around the pivot axle  
11 62 with arms 124 and 126. Arms 124 and 126 are interconnected to arms 114 and 116.  
12 When cylinders 130 and 132 move collars 120 and 122 to the right or to the left, pinned  
13 connections 134 and 136 move vertically away from the pivot axle 62. Bar 138  
14 interconnects grabbers 64 and 66 so that they remain in a fixed relative position. In this  
15 way a horizontal stroking of cylinders 130 and 132 provide for vertical extension and  
16 retraction of grabbers 64 and 66.

17 By this combination of extension and rotation, the grabbers can engage a new  
18 pipe section below the main erector arm, raise it to a position above the main erector  
19 arm and extend it into a position of matching the centerline of the mast after the erector  
20 has been appropriately raised.

21 The particular embodiments disclosed above are illustrative only, as the invention  
22 may be modified and practiced in different but equivalent manners apparent to those  
23 skilled in the art having the benefit of the teachings herein. Furthermore, no limitations  
24 are intended to the details of construction or design herein shown, other than as

1 described in the claims below. It is therefore evident that the particular embodiments  
2 disclosed above may be altered or modified and all such variations are considered  
3 within the scope and spirit of the invention. Accordingly, the protection sought herein is  
4 as set forth in the claims below.

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